

# **Evaluation and Demonstration of Operational Evolution Plan Improvements**

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## **Background**

The FAA and the aviation community have developed an operational concept built upon free flight that describes operational improvements the FAA plans to implement. This initiative, call the Operational Evolution Plan (OEP), is focused on meeting the demands of the aviation system for the next ten years. The objectives of the OEP are to maintain safety, increase capacity, and manage delays. To support these objectives the FAA, working with aviation industry representatives, identified a collection of National Airspace System (NAS) improvements encompassing decision support systems, flight deck automation, weather prediction tools, data link, airspace changes, new runways, and operational procedures. OEP improvements are consistent with the NAS Architecture that identifies services and capabilities to transition to free flight. The OEP is a 'living' document that will mature over time. Updates will occur as decisions are made, risks identified or mitigated, or new solutions to operational problems are found as a result of our research and development efforts. OEP improvements are grouped according to near term (2002), mid-term (2003-2004), and long-term (2005-2010) improvements. A number of accomplishments were reported in 2001.

The recently released version 4.0 of the OEP contains schedule adjustments necessary as a result of the terrorist attacks of September 11. New security requirements and temporarily reduced passenger demand dictate modifications to the OEP. In some cases, timelines have been extended to reflect current economic realities. In particular, delivery of new runways that depend on local airport funding and projects that require airline equipment are extended and aligned with projected investment milestones. FAA and the aviation community agree however on the need to move ahead with NAS modernization because air traffic will rebound and demand will again increase according to the pre 9-11 rate. With this demand will come the potential for capacity problems that hampered the NAS during the summer of 2000, when the OEP gained momentum as a business planning activity. Version 4.0 can be found on the FAA website at <http://www.faa.gov/programs/oep/>

Version 4.0 changes include:

- Houston Bush Intercontinental airport runway accelerated from 2004 to operational use in 2003;
- Minneapolis runway slipped from 2003 to 2004;
- Passive Final Approach Spacing Tool requires further refinement through research for successful and affordable implementation. Currently, no further operational use is planned.

- Collaborative decision making and enhanced traffic management system enhancements have been defined and planned for implementation in 2002.
- Controller pilot data link is on track for operational trials in June 2002 with implementation of the nationally deployed system in December 2005. This provides the opportunity to gain experience with the procedures, training, and technical aspects for data link and resynchronizes our mutual (government/industry) investment.
- User request evaluation tool enables more direct routes and in-flight restriction reduction. Implementation of URET has been moved up to include all CONUS centers by 2004.

The OEP details specific commitments and decisions needed by the aviation community to introduce new technology, airspace design, airport infrastructure and operational procedures that lead to capacity improvements. Accomplishment of OEP goals is dependent upon continuing coordination and cooperation within the aviation community. The RTCA Free Flight Steering Committee has accepted the role of facilitator and coordinator of industry alignment and commitment to the OEP.

The OEP effort has been subdivided into the following high-level improvements organized according to four core problem areas:

### **1.1 Arrival Departure Rate**

1. Build New Runways
2. Use Crossing Runway Procedures
3. Redesign Terminal Airspace and Routes
4. Fill Gaps in Arrival and Departure Streams
5. Expand Use of 3 Mile Separation Standard
6. Coordinate for Efficient Surface Movement
7. Enhance Surface Situation Awareness

### **1.2 En-Route Congestion**

1. Match Airspace Design to Demands
2. Reduce Vertical Separation
3. Reduce Voice Communication
4. Collaborate to Manage Congestion
5. Reduce Offshore Separation
6. Reduce Oceanic Separation
7. Accommodate User Preferred Routing
8. Provide Access to Restricted Airspace

### **1.3 Airport Weather Conditions**

1. Reconfigure Airports Efficiently
2. Space Closer to Visual Standards
3. Maintain Runway Use in Reduced Visibility

### **1.4 En-Route Severe Weather**

1. Respond Effectively to Hazardous Weather
2. Provide Better Hazardous Weather Data

Technical teams developed “smart sheets” for problem areas. A single Point of Delivery – called a POD – was assigned and accountable along with a cross agency support team for the smart sheets. The OEP and its solution sets contain only programs to be accomplished in the 2001 – 2010 time frame. Performance agreements and incentives link executives, organizations and shared goals. The FAA has aligned activities, budgets, and schedules to achieve OEP objectives.

The FAA Administrator has also appointed an Executive Director for the Operational Evolution Plan, naming Charles Keegan to that post. Keegan, formerly FAA’s Director of Free Flight, has responsibility for the coordination and oversight of the OEP. The OEP Team, composed of senior FAA executives, chaired by the Deputy Administrator, and with participation from the DoD, meets weekly to resolve policy issues and engage aviation community leaders in key decisions.

### **Evaluation Approach**

To better understand and quantify increased capacity resulting from improvements to the NAS, analysis, modeling, and simulation will be used to systematically establish a baseline of NAS performance from which we can measure the combined impact of improvements. FAA and aviation system users will then have the means to quantify the benefits OEP improvements provide, and whether these OEP-based measures are adequate to meet forecasted demand in 2010 and beyond.

During the development of the OEP, team members made a proposal to conduct a series of analyses including fast-time modeling and human in-the-loop simulations to measure performance of the NAS as if it were 2010.

Full scale modeling and simulation would support the development of operational procedures, identify and mitigate potential human factors issues, resolve integration and interoperability issues, and determine optimal airspace configurations to deliver capacity benefits. In an end-to-end demonstration of the full set of OEP improvements, it is envisioned that all of the controller tools would be in place, procedures would be written that approximate expected operations, airspace changes would be in effect, and various levels of avionics equipage would be addressed. Users would undergo prototype training as a means of determining end state training requirements. The addition of new runways would be included, along with their associated procedures, and the assumptions about traffic load and fleet mix would be based upon the expected configuration for the NAS in 2010. Aviation system users and service provider organizations would participate fully in the design and demonstration.

### **Changes in the NAS**

Numerous individual experiments and analyses have been conducted to assess benefits of changes proposed for the NAS. Changes in operational procedures have been defined and await modeling. Several technologies and tools are being demonstrated under Free Flight Phase 1 and 2 and Safe Flight 21. Twelve new runways are being planned for

benchmarked airports.<sup>1</sup> In addition, the aviation fleet mix is evolving. The use of regional jets is growing. A new class of aircraft, the Sonic Cruiser, has been proposed that will cruise higher and faster than current air carrier fleets. Others are proceeding with development of larger passenger aircraft. Cargo carriers, long the off-peak traffic operator at night, are spreading out their schedules and are expected to increase operations throughout the day. And as scheduled airline service becomes less convenient for the business executive, the demand for limited departure and arrival times at major airports will increase. All of these changes exert pushes and pulls on the NAS that alternately increase and decrease capacity. These pushes and pulls need to be factored into any experiments where future capacity is being assessed. Developing a baseline of the NAS will allow for a thorough analysis of improvements to determine to what extent OEP initiatives support forecasted demand.

## **Lessons Learned**

As a result of ongoing collaboration with NASA through the Interagency Air Traffic Management Integrated Product Team (IAIPT) and with participation from CAASD, industry, and academia who support NAS modernization programs, we have learned the necessity of going beyond a stovepipe approach in the development of research concepts to address the interoperability of multiple tools. As more tools and technologies become available to controllers and pilots, it is imperative that their capabilities are fully understood and their interrelationships defined and integrated through procedures and training. We have also learned that it is important to conduct research simulations and other operational evaluations within the parameters of intended operational usage. Managing user expectations about product capabilities is key to successful implementation as well. Building upon lessons learned, the objectives for a full scale simulation of OEP improvements were developed. The series of experiments will accomplish the following:

- Establish a NAS baseline;***
- Integrate procedures that use ATC tools and avionics;***
- Assess safety of OEP changes in the NAS;***
- Measure cockpit and controller workload and performance at 2010 traffic scenarios with all tools, avionics, and runways that are planned to be available;***
- Measure benefits to aid various business cases;***
- Identify risks to realizing expected OEP outcomes;***
- Measure impacts of convective weather, runway/airports closings, and other NAS events on the elasticity of the system;***
- Measure the impact of schedule assumptions on NAS loading;***
- Identify any disconnects, conflicting guidance, or other integration issues between ATC and flight deck tools and associated pilot/controller procedures;***
- Identify issues regarding the evolving roles and responsibilities between pilots and controllers; and***

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<sup>1</sup> FAA recently published the Airports Benchmarks report that focuses on the nation's top 31 airports and provides the capacity of these airports.

***-Build controller and pilot confidence in the 2010 NAS.***

The test approach begins with a review of existing experimental results to leverage the work of individual programs, followed by a definition of small experiments that incrementally build to a day in the NAS. Researchers at the William J. Hughes Technical Center recently undertook an effort to identify assets to accomplish fast-time modeling and human-in-the-loop simulations envisioned by the OEP development team. They determined that assets exist across the nation that can be interfaced to produce simulations of a flight day. While a number of lab infrastructure enhancements will need to be identified early to allow for system upgrades and testing, it is obvious that a wealth of resources exist in several different organizations. These assets include:

- Air Traffic Control, tower, and flight simulation capabilities at the FAA Technical Center;
- Integration facilities for Free Flight Phase 1 and 2;
- Air Traffic Control System Command Center traffic management capabilities and AOC Net;
- FAA flight simulator at the FAA Aeronautical Center in Oklahoma City, Oklahoma;
- NASA Ames flight and ATC (e.g. tower) simulation capabilities;
- DOD simulators at selected military locations and
- Airline flight training simulators.

See Figure 1 for a more detailed depiction of selected simulation capabilities that can support the OEP.

Likewise, FAA and NASA are assessing current modeling capabilities among organizations who conduct air traffic management research. To better understand existing capabilities, the Technical Center is hosting a technical information meeting in April 2002. The meeting will begin with a review of existing experimental results to better understand the work of individual programs, followed by a definition of a series of increasingly complex experiments. Meeting participants will review their current research, and highlight their methodology, tool set, fidelity, assumptions, objectives, and results.

## **The Approach**

Planning begins with completion of problem statements and identification of issues. Areas of concern will be documented early using a structured design process to define the necessary analyses, modeling, and simulation. NAS operations will be decomposed into component parts to identify specific issues relative to performance and traffic densities, for the nominal and non-nominal case. Non-nominal scenarios will include effects of weather, aircraft problems, and runway configurations. Traditionally, simulation and modeling activities are more narrowly focused on technical performance or airport throughput performance of a particular change. In NAS 2010, our focus will be on system-wide operational problems and issues, not limited to justification of a particular program. Considerable stakeholder involvement is envisioned to define assumptions, structure research questions, and identify issues and concerns. Examples of stakeholder

questions would be “what do you need to know” and “what would you consider proof that an improvement works and provides expected benefits?”

The next step is to group together the problems, issues, and concerns into phases of flight and flight planning. This will create a natural grouping of interdependent activities that can then be linked to NAS domains (surface, terminal, en route, oceanic, flight planning, traffic management). Cross-flight phase issues would be carried within each domain, with the linkage between domains defined. Problem statements are prepared for each issue or concern.

Allocation of research to various methods of engineering analysis, modeling, or simulation will then be made since it is typically fast-time simulation that produces the business case and human in-the-loop simulation that defines safety, workload, and performance issues and helps build confidence in proposed changes. Some issues can be resolved by analysis, some by modeling, and still others by a combination of fast-time and human-in-the-loop simulations. Several iterations of these activities will be needed to refine performance metrics.

After domain simulations, airports and airspace are linked, based upon chosen city pairs from the 31 benchmarked airports and connecting airspace. Pilot and controller teams would be trained on use of new technology, new procedures, and operations in different airspace structures. These teams would be the core for early work on assumptions, procedure development, and staffing the day in the NAS 2010 events. NAS 2010 scenarios would be developed that measure workload changes, failure modes, and unexpected consequences.

### **Path to Success**

The OEP requires the active participation and commitment of both industry and government. To ensure success, FAA will work closely with representatives from NASA, as well as the entire aviation community, including airlines, airports, manufacturers, service providers, pilots, controllers and passengers. FAA will realign its resources as needed to evaluate and measure capacity benefits and take full advantage of maturing technology and initiatives that demonstrate cost benefit advantages.